

CLAIMS

What is claimed is:

1. A process for preparing a film or sheet having a glass transition
5 temperature below about 23°C and a melting temperature greater than
about 120°C comprising the steps of:
 - (a) preparing a polyester composition comprising
 - (i) about 50 to about 95 weight percent of a base
10 copolyester having a melting temperature of less than about 220°C
and exhibiting more than about 1 percent crystallinity after annealing
for 2000 minutes at a temperature of which the base copolyester has
a maximum crystallization rate, and
 - (ii) about 5 to about 50 weight percent of a plasticizer
suitable for use with the base copolyester;
 - 15 (b) forming the polyester composition into a film or sheet; and
 - (c) inducing crystallization during step (b) or after step (b).
2. The process of claim 1 wherein the film or sheet has a glass
20 transition temperature below about 0°C.
3. The process of claim 2 wherein the film or sheet has a melting
temperature greater than about 140°C.
4. The process of claim 1 wherein the film or sheet has a melting
25 temperature greater than about 140°C.
5. The process of claim 1 wherein the polyester composition comprises
from about 50 to about 80 weight percent of the base copolyester and from
about 20 to about 50 weight percent of the plasticizer.

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6. The process of claim 5 wherein the polyester composition comprises from about 60 to about 75 weight percent of the base copolyester and from about 25 to about 40 weight percent of the plasticizer.

5 7. The process of claim 1 wherein the base copolyester comprises
(i) a diacid component comprising residues of at least about 80 mole percent of a primary diacid selected from the group consisting of terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, isophthalic acid and mixtures thereof and

10 (ii) a diol component comprising residues of at least about 80 mole percent of at least one primary diol containing 2 to about 10 carbon atoms,
based on 100 mole percent of the diacid component and 100 mole percent of the diol component.

15 8. The process of claim 7 wherein the diacid component further comprises residues of up to about 20 mole percent of a modifying diacid containing from about 4 to about 40 carbon atoms.

20 9. The process of claim 8 wherein the modifying diacid is selected from the group consisting of succinic acid, glutaric acid, adipic acid, suberic acid, sebacic acid, azelaic acid, dimer acid, sulfoisophthalic acid, and mixtures thereof.

25 10. The process of claim 7 wherein the primary diol is selected from the group consisting of ethylene glycol, diethylene glycol, neopentyl glycol, 1,4-cyclohexanedimethanol and mixtures thereof.

11. The process of claim 7 wherein the primary diol comprises residues of from about 10 to 100 mole percent 1,4-cyclohexanedimethanol and from 0 to about 90 mole percent ethylene glycol.

5 12. The process of claim 11 wherein the primary diol comprises from about 10 to about 40 mole percent 1,4-cyclohexanedimethanol and about 60 to about 90 mole percent ethylene glycol.

10 13. The process of claim 12 wherein the plasticizer is present in an amount of about 20 to about 50 weight percent.

15 14. The process of claim 7 wherein the diol component further comprises residues of up to about 20 mole percent of a modifying diol selected from the group consisting of 1,3-propanediol, propylene glycol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, and polyalkylene glycol.

20 15. The process of claim 1 wherein the plasticizer dissolves a 5-mil (.127 mm) thick film of the base copolyester to produce a clear solution at a temperature below 160°C.

25 16. The process of claim 1 wherein the plasticizer has a solubility parameter in the range from about 9.5 to about 13.0 cal^{0.5}cm^{-1.5}.

30 17. The process claim 1 wherein the plasticizer is an ester based on
(i) an acid moiety selected from the group consisting of phthalic acid, adipic acid, trimellitic acid, benzoic acid, azelaic acid, terephthalic acid, isophthalic acid, butyric acid, glutaric acid, citric acid and phosphoric acid and

(ii) an alcohol moiety selected from the group consisting of aliphatic, cycloaliphatic, and aromatic alcohols containing from about 1 to about 20 carbon atoms.

5 18. The process of claim 17 wherein the alcohol moiety of the plasticizer is selected from the group consisting of methanol, ethanol, propanol, isopropanol, butanol, isobutanol, stearyl alcohol, lauryl alcohol, phenol, benzyl alcohol, ethylene glycol, neopentyl glycol, 1,4-cyclohexanedimethanol, diethylene glycol.

10 19. The process of claim 1 wherein forming the film or sheet is by melt extrusion.

15 20. The process of claim 1 wherein forming the film or sheet is by cast extrusion.

21. The process of claim 1 wherein inducing crystallization is after step (b) and is by stretching.

20 22. The process of claim 1 wherein inducing crystallization is after step (b) and is by annealing at a temperature greater than the glass transition temperature of the film and less than melting temperature of the base copolyester.

25 23. The process of claim 1 wherein forming the sheet and inducing crystallization occur during step (b) by calendering or blown film extrusion.

24. A process for preparing a film or sheet comprising the steps of:

(a) preparing a polyester composition comprising

(i) about 50 to about 80 weight percent of a base

copolyester having a melting temperature of less than about 220°C and a glass transition temperature of greater than about 60°C and exhibiting more than about 1 percent crystallinity after annealing for 2000 minutes at a temperature of which the base copolyester has a maximum crystallization rate, and

(ii) about 20 to about 50 weight percent of a plasticizer

suitable for use with the base copolyester.

(b) forming the polyester composition into a film or sheet; and

(c) inducing crystallization during step (b) or after step (b);

and wherein after step (c) the film or sheet has a glass transition temperature below about 23°C and a melting temperature greater than about 140°C.

25. The process of claim 24 wherein the base copolyester comprises a diacid component comprising residues of at least about 80 mole percent of a primary diacid selected from the group consisting of terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, isophthalic acid and mixtures thereof and a diol component comprising residues of about 10 to about 40 mole percent 1,4-cyclohexanedimethanol and about 60 to about 90 mole percent ethylene glycol, based on 100 mole percent of the diacid component and 100 mole percent of the diol component.

26. The process of claim 24 wherein the plasticizer is selected from the group consisting of neopentyl glycol dibenzoate, diethylene glycol dibenzoate, butyl benzyl phthalate; texanol benzyl phthalate.

27. A film or sheet having a glass transition temperature below about 23°C and a melting temperature greater than about 120°C and comprising a polyester composition comprising

5 (a) about 50 to about 95 weight percent of a base copolyester having a melting temperature of less than about 220°C and exhibiting more than about 1 percent crystallinity after annealing for 2000 minutes at a temperature of which the base copolyester has a maximum crystallization rate and

10 (b) about 5 to about 50 weight percent of a plasticizer suitable for use with the base copolyester.

28. The film or sheet of claim 27 wherein the base copolyester is present from about 50 to about 80 weight percent and the plasticizer is present from about 20 mole percent to about 50 weight percent.

15 29. The film or sheet of claim 27 wherein the base copolyester comprises

20 (i) a diacid component comprising residues of at least about 80 mole percent of a primary diacid selected from the group consisting of terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, isophthalic acid and mixtures thereof and

25 (ii) a diol component comprising residues of at least about 80 mole percent of at least one primary diol containing 2 to about 10 carbon atoms, wherein the diacid component is based on 100 mole percent and the diol component is based on 100 mole percent.

30 30. The film or sheet of claim 29 wherein the diacid component comprises residues of up to about 20 mole percent of a modifying diacid containing from about 4 to about 40 carbon atoms.

31. The film or sheet of claim 30 wherein the modifying diacid is selected from the group consisting of succinic acid, glutaric acid, adipic acid, suberic acid, sebacic acid, azelaic acid, dimer acid, and sulfoisophthalic acid.

5 32. The film or sheet of claim 29 wherein the primary diol is selected from the group consisting of ethylene glycol, diethylene glycol, neopentyl glycol, 1,4-cyclohexanedimethanol and mixtures thereof.

10 33. The film or sheet of claim 29 wherein the primary diol comprises residues of about 10 to 100 mole percent 1,4-cyclohexanedimethanol and 0 to about 90 mole percent ethylene glycol.

15 34. The film or sheet of claim 33 wherein the primary diol comprises from about 10 to about 40 mole percent 1,4-cyclohexanedimethanol and about 60 to about 90 mole percent ethylene glycol.

20 35. The film or sheet of claim 29 wherein the diol component comprises residues of up to about 20 mole percent of a modifying diol selected from the group consisting of 1,3-propanediol, propylene glycol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, and polyalkylene glycol.

25 36. The film or sheet of claim 27 wherein the plasticizer dissolves a 5-mil thick film of the base copolyester to produce a clear solution at a temperature below 160°C.

30 37. The film or sheet of claim 27 wherein the plasticizer has a solubility parameter in the range from about 9.5 to about 13.0 cal^{0.5}cm^{-1.5}.

38. The film or sheet of claim 27 wherein the plasticizer is an ester based on

(i) an acid moiety selected from the group consisting of phthalic acid, adipic acid, trimellitic acid, benzoic acid, azelaic acid, terephthalic acid, isophthalic acid, butyric acid, glutaric acid, citric acid and phosphoric acid and

(ii) an alcohol moiety selected from the group consisting of aliphatic, cycloaliphatic, and aromatic alcohols containing from about 1 to about 20 carbon atoms.

39. The film or sheet of claim 38 wherein the alcohol moiety of the plasticizer is selected from the group consisting of methanol, ethanol, propanol, isopropanol, butanol, isobutanol, stearyl alcohol, lauryl alcohol, phenol, benzyl alcohol, ethylene glycol, neopentyl glycol, 1,4-cyclohexanedimethanol, diethylene glycol.

40. The film or sheet of claim 27 wherein the film or sheet has a glass transition temperature below about 0°C.

41. The film or sheet of claim 40 wherein the film or sheet has a melting temperature greater than about 140°C.

42. The film or sheet of claim 27 wherein the film or sheet has a melting temperature greater than about 140°C.

43. A film or sheet having a glass transition temperature below about 23°C and a melting temperature greater than about 140°C and comprising a polyester composition comprising

(a) about 50 to about 80 weight percent of a base copolyester having a melting temperature of less than about 220°C and a glass

transition temperature of greater than about 60°C and exhibiting more than about 1 percent crystallinity after annealing for 2000 minutes at a temperature of which the base copolyester has a maximum crystallization rate, and

- 5 (b) about 20 to about 50 weight percent of a plasticizer suitable for use with the base copolyester.

44. The film or sheet of claim 43 wherein the base copolyester comprises a diacid component comprising residues of at least 80 mole
10 percent of a primary diacid selected from the group consisting of terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, isophthalic acid and mixtures thereof and a diol component comprising residues of about 10 to about 40 mole percent 1,4-cyclohexanedimethanol and about 90 to 60 mole percent ethylene
15 glycol, wherein the diacid component is based on 100 mole percent and the diol component is based on 100 mole percent.

45. The film or sheet of claim 44 wherein the plasticizer is selected from the group consisting of neopentyl glycol dibenzoate, diethylene glycol
20 dibenzoate, butyl benzyl phthalate; texanol benzyl phthalate.